Buckyball studied by photoemission:
from molecular crystals to novel conductors

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When C60, also named "buckyball", was discovered in 1985, it was dubbed "the most beautiful molecule". More excitingly, this carbon based molecule exhibits many novel properties when doped with electrons, a famous example is the superconductivity with Tc up to 40K. Also, C60 provides us a model system to study many-body physics because the energy scales of both electron-electron interactions and phonon frequency are comparable with the small band width. To study the electronic structure of C60 is then of both scientific and practical interests.

As a typical molecular crystal system, the C60 molecules are only weakly bound together in the solid, leading to a small band width. Further, the extra degrees of freedom, e.g., molecular orientation, also play an important role on electronic structure. These, as well as some other intrinsic characteristics, impose a great difficulty far beyond resolution-requirements on detecting the band structure of C60 solid, which is fundamentally crucial for understanding the novel properties.

In this talk, I'll present some of the previous (2003) data on successfully detecting the band structure of C60 monolayers by ARPES, followed by a direct demonstration on the extreme importance of molecular orientation in a system like C60. Then I'll further discuss the phase equilibrium of C60 at different doping level, showing the evidence of phase separation in monolayers and the novel doping behaviors.